

## SHORTER NOTES

**Three Forms of *Ceratopteris thalictroides* in Guam.**—Guam is the type locality of *Ceratopteris gaudichaudii* Brongn., an endemic species described by Brongniart in 1821. Some taxonomists regarded it as an independent species in *Ceratopteris* (e.g. Wagner and Grether, B. P. Bishop Mus. Occasional Papers 19:77–78. 1948), but others considered it to be a form of *Ceratopteris thalictroides* (L.) Brongn. (e.g. De Vol, *Taiwania* 13:1–11, 1967). The latest revision of the genus *Ceratopteris* was made by Lloyd (*Brittonia* 26:139–160. 1974). He reduced several species including *C. gaudichaudii* to *C. thalictroides*. We have carried out molecular analyses for *C. thalictroides* and found that *C. thalictroides* sensu Lloyd contains at least three cryptic species, tentatively named the south type, the north type and the third type, which may be distributed in tropical to subtropical regions, eastern Asia to Micronesia, and Indonesia and its neighboring areas, respectively (Masuyama *et al.*, *J. Plant Res.* 115:87–97. 2002).

The first author of this report visited Guam and collected three distinct forms of *C. thalictroides*. One was found at a stream on Mt. Santa Rosa, Yigo in 1998 and the others were at a taro patch in Agana Swamp, Agana in 2006. Plants of Yigo (Fig. 1A) were almost submerged in a stream. They were relatively small and similar to *Ceratopteris* plants of Hawaii in leaf morphology. Sterile leaves were about 20 cm long at most and had long deltoid blades and relatively short stipes of 1/4 to 1/3 the length of the blades, which were tripinnatifid with obtuse elliptic ultimate segments. Fertile leaves were about 25 cm long at most and tripinatifid with long deltoid blades and relatively short stipes. In Agana Swamp, two distinct forms were found; one was small while the other fairly large. Small plants (Fig. 1B) were mostly growing on wet mud, though several plants submerged completely in ditch streams, rooting on ditch walls. They showed characteristics of *C. gaudichaudii*. Sterile leaves were about 10 cm long at most and had deltoid to long deltoid blades with relatively short stipes of 1/3 to 1/2 the length of the blades, which were tripinnatifid with acute lanceolate ultimate segments. The leaves frequently formed gemmae on sinuses of ultimate segments and outlines of segments consequently appeared somewhat dentate. Acute lanceolate lobes and dentate edges of segments are good diagnostics of *C. gaudichaudii* as noted by Wagner and Grether (1948) and Fosberg (*Amer. Fern J.* 40:35–39. 1950), respectively. Fertile leaves were about 15 cm long at most, tripinnatifid, and had deltoid to long deltoid blades with relatively short stipes. Large plants, on the other hand, were growing in aquatic sites, rooting on mud bottoms and arising in the air or swinging in ditch streams. Sterile leaves were up to 30 cm long and fertile leaves were up to 50 cm long. Their features were of typical *C. thalictroides*; sterile leaves were tri- to tetrapinnatifid with long deltoid blades and relatively long stipes which were as long as the blades in some individuals, bearing pinnae rather sparsely on rachises and having obtuse

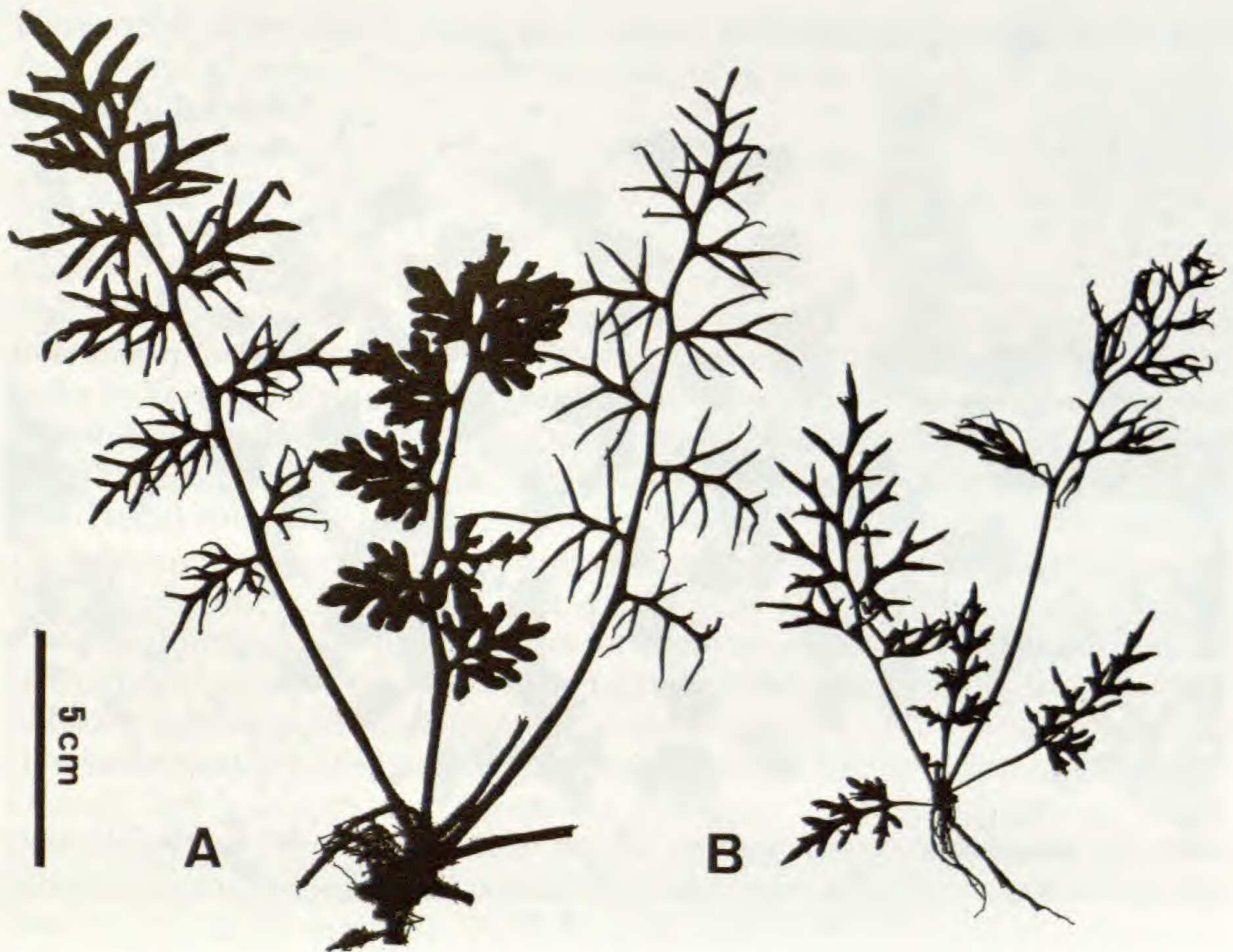


FIG. 1. Two forms of *C. thalictroides* in Guam. A, a plant in Yigo; B, a small plant in Agana. The specimen of the large Agana form was deposited in GUAM.

elliptic to wide-elliptic ultimate segments. Fertile leaves were tetra- to pentapinnatifid with long deltoid blades and relatively long stipes as well as sterile leaves.

As for the Yigo form, molecular and cytological studies have shown that its *rbcL* gene sequence is of the north type (DDBJ accession number AB059575; Masuyama *et al.*, 2002) and its chromosome number is  $n=78$  and  $2n=156$ , the number characteristic of the north type and the third type (Masuyama and Watano, *Acta Phytotax. Geobot.* 56:231–240. 2005).

To understand the relationships of the three forms in Guam, we examined the *rbcL* gene sequence and the chromosome number of the small Agana form, following the methods in Adjie *et al.* (*J. Plant Res.* 120:129–138. 2007) and Masuyama and Watano (2005), respectively. Its *rbcL* gene sequence was identical to that of the Yigo form. The chromosome number was  $n=78$  (Fig. 2), also the same as the Yigo form. Although the large Agana form has not been investigated as to the *rbcL* gene sequence and the chromosome number, it probably belongs to the south type, judging from the leaf morphology noted above. Thus, two types of *C. thalictroides* are present in Guam; one is the north type exemplified by the Yigo form and the small Agana form, the form

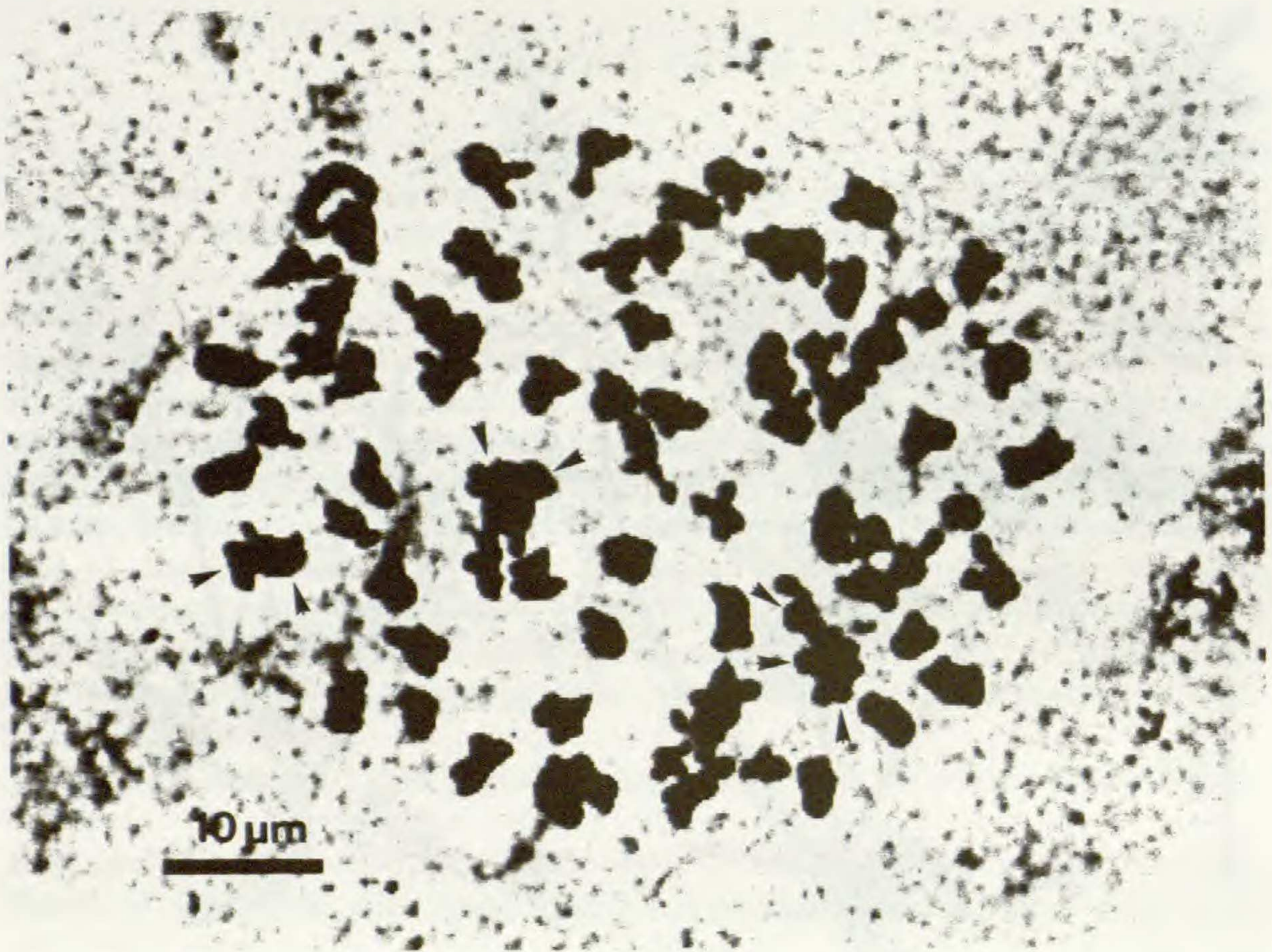


FIG. 2. Meiosis of the small Agana form showing  $n=78$ . Arrow heads indicate overlapping single bivalents.

regarded as *C. gaudichaudii*, and the other is the south type exemplified by the large Agana form. Most of the specimens of domestic *C. thalictroides* kept in GUAM show the characteristics of *C. gaudichaudii* and there is no specimen that appears to be the large Agana form, though plants of the large Agana form were not rare but so numerous as to be detected easily in Agana Swamp. It is, therefore, likely that the large Agana form may not be endemic in Guam but may have been introduced relatively recently.

Masuyama *et al.* (2002) considered the south type, the north type and the third type to be independent species. Because *C. gaudichaudii* has distinct morphological features as compared with the Yigo form and other sources of the north type, it should be treated as a variety of the independent species referred so far as the north type. Species descriptions of the three types in *C. thalictroides* are in preparation.

Voucher specimens of Agana plants examined for the DNA sequence and the chromosome number were deposited in GUAM.

We are grateful to Dr. L. Raulerson of The University of Guam for her kind help in collecting *Ceratopteris* plants in Guam and examining the specimens in the herbarium GUAM.—SHIGEO MASUYAMA, Department of Mathematics and Natural Sciences, College of Arts and Sciences, Tokyo Woman's Christian

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**Contribution to the Pteridophyte Flora of Puerto Rico.**—Despite its age, Proctor's *Ferns of Puerto Rico and the Virgin Islands* (1989) is the most utilized taxonomic treatment used by pteridologists to identify Puerto Rican ferns. In order to keep the taxonomy current, we are reporting twenty new ferns that are Puerto Rican municipio records. During the course of our fieldwork we visited more than 60 of Puerto Rico's 76 municipios, and our collection ranged from the coastal lowlands to the central Cordillera Mountains. The new pteridophyte records were collected in thirteen different municipios, mostly from the central portion of the island and a few from the southeast coast (Fig. 1). Previous Puerto Rican distributions for these taxa were obtained from Proctor (*Ferns of Puerto Rico and the Virgin Islands*. Mem. New York Bot. Gard. 53:1–389. 1989), Barcelona (Systematics of the fern genus *Odontosoria sensu lato* (Lindsaeaceae). Ph.D. dissertation, Department of Botany, Miami University, Oxford, Ohio. 2000), and Shaw *et al.* (New Records for Puerto Rican Pteridophytes. Fern Gaz. 17(2): 97–99. 2004.). Because most of the new records were collected in the central region of Puerto Rico this suggest that this area may be under sampled. The following records are arranged alphabetically by municipios and the specimens are housed at the Willard Sherman Turrell Herbarium (MU) at Miami University.

**Adjuntas: *Psilotum nudum* (L.) P. Beauv.** Record voucher: Puerto Rico, Municipio de Adjuntas growing in Adjunta at the base of a palm tree on the front lawn of a house northwest of the hotel Monte Rio at an elevation of 479 m, N 18° 09' 44.2" W 66° 43' 33.8". Collected 23 May 2006 by S.W. Shaw, M.S. Barker # 489, and S.V. Sprunt. Previously known Puerto Rico distribution: Arecibo, Bayamón, Dorado, Juana Díaz, Maricao, Ponce, and Quebradillas. Of wide occurrence but not often collected.

**Arecibo: *Pteris vittata* L.** Record voucher: Puerto Rico, Municipio de Arecibo, growing along a muddy wall along the side of Rt. 623 at an elevation of 183 m, N 18° 23' 32.7" W 66° 42' 38.6". Collected 20 May 2006 by S.W. Shaw, M.S. Barker # 457, and S.V. Sprunt. Previously known Puerto Rico distribution: Camuy, Isabela, Ponce, San Juan, and Vega Alta. Very widespread but not often collected.

**Hatillo: *Microgramma lycopodioides* (L.) Copel.** Record voucher: Puerto Rico, Municipio de Hatillo, growing on a tree alongside Rt. 134 near the driveway to Bayaney Dairy Inc. at an elevation of 305 m, N 18° 21' 18.3" W 66° 48' 49.1". Collected 20 May 2006 by S.W. Shaw, M.S. Barker # 459, and S.V. Sprunt. Previously known Puerto Rico distribution: Arecibo, Cayey, Dorado, Gurabo, Jayuya, Luquillo, Manatí, Maricao, Naguabo, Salinas, San Germán, Utuado, Yabucoa, and Yauco. Of wide occurrence. ***Nephrolepis hirsutula* (G. Forst.) C. Presl.** Record voucher: Puerto Rico, Municipio de Hatillo, growing on a tree